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## Description

This invention relates to venting systems for electric storage batteries and more particularly to venting systems which include a microporous filter which permits the egress of gases from the battery cell (s) while preventing the ingress of flame thereto.

Battery manufacturers typically provide starting-lighting-ignition (SLI) batteries (e.g., Pb-acid) with a venting system which: traps electrolyte and refluxes it back to the interior of the battery while still permitting egress of any internally generated gases to the ambient atmosphere. Such venting systems are typically equipped with a microporous filter (e.g., sintered polypropylene, or SiC) which is located proximate the venting system's exhaust port and so arranged that all of the gases pass through the filter. Such filters have proved to be highly effective means for intercepting and quashing transient flames resulting from external ignition of the gases, and thereby prevent propagation of such flame(s) back into the cells. Such filters have also proved to be temporarily effective against sustained flame(s), but can eventually be damaged if direct exposure thereto is prolonged.

At least one manufacturer has suggested that prolonged exposure of the filter to a flame can be eliminated by locating the filter inwardly of the exhaust port and providing a combustion chamber interjacent the filter and the exhaust port. The combustion chamber lies contiguous the filter and provides for a controlled combustion of the gases in the chamber which is such as to extinguish or "blow out" any ignited gases that would otherwise continuously stream from the exhaust port. Such designs, however, expose the filter directly to the heat and force generated by the expanding gases ignited in the combustion chamber which itself may dislodge the filter from position or otherwise deleteriously affect the filter and shorten its useful life.

It is the principal object of the present invention to provide a battery venting system with: a porous filter for permitting gas egress from the battery while preventing flame ingress into the battery; a battery gas combustion chamber to disrupt flames occurring at the exhaust port; a buffering means between the filter and the chamber to insulate the filter from the heat and percussive forces generated in the combustion chamber by ignition of the gases therein; and means to direct the flow of expanding gases such as to extinguish any flames at the battery's exhaust port; whereby the effectiveness of the filter is prolonged even at high levels of overcharge (e.g., 40 amps). This and other objects and advantages of the present invention will become more readily apparent from the detailed description thereof which follows.

## Brief Description of the Invention

This invention comprehends a battery gas venting system which includes: an electrolyte-trap-

ping chamber in gas-flow communication with a cell(s) of a battery; a porous flame-arresting filter through which the battery gases pass before exiting the battery and which serves to extinguish any flame attempting to pass back (i.e., counter to the outflow of gas) therethrough; an exhaust port for venting the gases to the ambient atmosphere; a combustion chamber adjacent the exhaust port for the controlled combustion of battery gases; a buffer chamber intermediate the porous filter and the combustion chamber for mitigating the impact of forces generated in the combustion chamber on the filter; a partition separating the combustion and buffer chambers; and an aperture communicating the combustion and buffer chambers one with the other, wherein the cross-sectional area of the aperture is sufficiently less than the cross-sectional area of the exhaust port that the expanding gases resulting from the controlled combustion are preferentially directed outwardly through the gas port to "blow out" or extinguish any flame thereat and thereby to prevent the establishment of a sustained flame at the exhaust port. Preferably the ratio of the cross-sectional area of the exhaust port of the effective cross-sectional area of the inter-chamber aperture will be at least 2:1 and most preferably about 2.5:1 or more. In a particularly preferred embodiment, the venting system is a manifold for venting a plurality of cells through a common exhaust port(s).

## Detailed Description of a Preferred Embodiment of the Invention

The invention disclosed herein may best be illustrated by reference to a preferred embodiment thereof which is described hereafter in conjunction with the following drawings in which:

Figure 1 is an isometric view of a Pb-acid, SLI battery having a 6-cell venting manifold in accordance with the present invention;

Figure 2 is a partially broken-away plan view in the direction 2—2 of Figure 1;

Figure 3 is an enlarged side sectioned view taken in the direction 3—3 of Figure 2;

Figure 4 is a bottom view taken in the direction 4—4 of Figure 3; and,

Figure 5 is a front sectional view taken in the direction 5—5 of Figure 3.

Figure 1 depicts a storage battery 2 having a case 4 which, in the case of an automotive SLI battery, houses six discrete Pb-acid cells 17. The several cells include a stack of lead positive and negative plates immersed in a sulphuric acid electrolyte. A cover 6 is sealed to the case 4 so as to contain the electrolyte and isolate one cell from the other. During period of excessive overcharge, the water in the electrolyte is decomposed into its constituent gases. These gases must be vented to the ambient atmosphere to prevent pressure buildup and eventual bulging of the case 4.

Venting of the battery gases is effected by means of venting system housed between the top of the cover 6 and a mating lid 10, as is well

known in the art. Such venting systems 8 typically include gas vent and electrolyte reflux openings 12 at the low point of an electrolyte-trapping chamber 14 which also includes an appropriate baffle means 15 for providing a tortuous electrolyte travel path through the trapping chamber 14. The precise arrangement of the electrolyte-trapping chamber 14 illustrated is not a part of the present invention and accordingly shall not be dwelt upon herein. Rather the particular trapping chamber arrangement shown is the subject of copending European patent application EP-A-0 107 469 filed October 17, 1983, which copending application is hereby incorporated by reference to the extent it may be useful. Suffice it to say that each battery cell 17 has a corresponding electrolyte-trapping chamber 14 in the venting system and the several trapping chamber 14 are intercommunicated one with the other via notches 18 in septums 20 to form a manifold for conducting all of the battery gases to the ambient atmosphere via single exhaust port 16. The exhaust port 16 is backed by the sustained-flame-disrupting structure of the present invention. This sustained-flame-disrupting structure is generally indicated at 22 and will be discussed in more detail hereinafter.

To exit the battery, the gases from the several electrolyte-trapping chambers 14 enter an end chamber 14a, pass upwardly through a conventional microporous flame arresting filter 24 and ultimately pass to the ambient atmosphere via exhaust port 16. Means 22, according to the present invention, are provided between the filter 24 and the exhaust port 16 to prevent the establishment of a sustained flame at the mouth of the exhaust port 16 without subjecting the porous filter to potentially destructive forces. This sustained-flame-disrupting means 22 comprises a buffer chamber 26 adjacent the filter 24, a combustion chamber 28 adjacent the exhaust port 16 and a partition 30 separating the two chambers 26 and 28. An aperture 32 through the partition 30 interconnects the buffer chamber 26 with the combustion chamber 28 so that gases entering the buffer chamber 26 from filter 24 pass through combustion chamber 28 before leaving the battery via exhaust port 16. In this particular embodiment of the invention the buffer chamber 26 is quite narrow and lies between the upper face 23 of the filter 24 and the underside of lid 10. A discontinuous annular shoulder 34 is moulded on the underside of the lid 10 and keeps the filter 24 appropriately spaced from the underside of the lid 10 during assembly. After positioning against the shoulder 34, the filter 24 is held in place, as by heat-staked retention tabs 36, on the underside thereof (see Figures 3 and 4).

The combustion chamber 28 is positioned between the buffer chamber 26 and the port 16 and serves to provide a region in the venting system where controlled combustion can occur. The limited availability of oxygen in the combustion chamber 28 prevents continuous burning therein as well as back into the buffer chamber 26.

In the particular embodiment depicted and for moulding convenience, the actual cross-sectional area of the aperture 32 between the buffer chamber 26 and combustion chamber 28 is approximately the same as the cross-sectional area of the exhaust port 16. In this instance, however, the effective cross-sectional area of the aperture 32 (i.e., for gas flow purposes) is substantially less than its actual cross-sectional area since a corner 40 of the filter 24 block much of the aperture's opening. Hence, in this instance, the effective cross-sectional area of the aperture 32 is the size of the orifice 38 defined by the upper surface of the corner 40, the underside of the lid 10 and the end walls 37 of the discontinuous shoulder 34. It is the size of the orifice 38 then that determines the flow between the buffer and the combustion chambers and, as shown here, is less than half the size (i.e., cross-sectional area) of the port 16. Regardless how formed, the size of the aperture or orifice, as the case may be, is sufficiently less than the cross-sectional area of the exhaust port 16 as to ensure that the expanding ignited gases in combustion chamber 28 preferentially stream out of the exhaust port 16 so as to "blow out" or otherwise thwart the establishment of a sustained flame thereat. Meanwhile the gases in the buffer chamber 26 apparently act like a cushion to mitigate the percussive impact of the ignited gases on the filter 24 as well as to insulate the filter 24 from the heat generated in the combustion chamber 28.

To illustrate the effectiveness of the present invention, standard commercial, lead-acid storage batteries manufactured by Applicant were equipped with sustained-flame-disrupting means 22 such as shown in the several Figures wherein the buffer chamber 26 had a volume of about 0.15 cc, a combustion chamber 28 having a volume of about 0.74 c, an exhaust port having a cross-sectional area of 11.4 mm<sup>2</sup> and an inter-chamber aperture having an effective cross-sectional area (i.e., orifice 38) of 4.56 mm<sup>2</sup>. The batteries were subjected to the Battery Council International's Recommended Test Procedure For Battery Safety Vents (i.e., 12-Volt). In this regard, the batteries were overcharged at the rate of 40 ampere and a continuous spark maintained at the exhaust port 16. This test was characterized only by a rapid succession of audible "pops" at the port 16. At no time during the course of the test did a flame persist at the port 16.

While this invention has been described primarily in terms of a specific embodiment thereof it is not intended to be limited thereto but rather only to the extent set forth hereafter in the claims which follow.

#### Claims

1. A venting system (8) for an electric storage battery (2) including an exhaust port (16) for venting battery gases to the ambient atmosphere and means for quashing any flame invading said system through said port (16), said means in-

cluding a porous flame-arresting filter (24) intermediate a cell (17) of said battery (2) and said port (16) for permitting egress of said gases while preventing ingress of said flame and a combustion chamber (28) adjacent said port (16) for the controlled combustion of said gases therein, characterised in that said flame-quashing means includes a buffer chamber (26) intermediate said combustion chamber (28) and said filter (24) to mitigate the impact of said controlled combustion on said filter (24); a partition (30) separating said combustion and buffer chamber (26, 28) one from the other; and an aperture (32) through said partition (30) connecting said combustion and buffer chambers, said aperture (32) having an effective cross-sectional area which is sufficiently less than the cross-sectional area of said port (16) that the forces generated by said controlled combustion are relieved primarily through said port (16) and serve to prevent establishment of a sustained flame at said port (16) incident to the ignition of said gases thereat.

2. A venting system (8) for an electric storage battery (2) according to claim 1, characterised in that said aperture (32) has a cross-sectional area of no more than one half the cross-sectional area of said port (16).

#### Patentsprüche

1. Entgasungssystem (8) für eine elektrische Speicherbatterie (2) mit einer Entgasungsöffnung (16) zum Abführen von Batteriegasen an die Umgebungs-Atmosphäre und Mitteln zum Abweisen einer in das System durch die Öffnung (16) eindringenden Flamme, wobei die Mittel ein poröses, flammensperrendes Filter (24) zwischen einer Zelle (17) der Batterie (2) und der Öffnung (16), das das Austreten der Gase unter Verhüten von Eindringen der Flamme zuläßt, und eine Verbrennungskammer (28) benachbart zu der Öffnung (16) für die gesteuerte Verbrennung der Gase darin enthalten, dadurch gekennzeichnet, daß die flammenabweisenden Mittel eine Puffer-Kammer (26) zwischen der Verbrennungskammer (28) und dem Filter (24) einschließen, um das Auftreffen der gesteuerten Verbrennung auf das Filter (24) abzuleiten, eine die Verbrennungs-(26) von der Puffer-Kammer (28) abtrennende Teilwand (30) und einen Durchbruch (32) durch die Teilwand, der die Verbrennungs- mit der Puffer-Kammer verbindet, wobei der Durchbruch (32) eine effektive Querschnittsfläche besitzt, die ausreichend kleiner als die Querschnittsfläche der

Öffnung (16) ist, so daß die durch die gesteuerte Verbrennung erzeugten Kräfte primär durch die Öffnung (16) abgeleitet werden und dazu dienen, eine Errichtung der aufrechterhaltenen Flamme an der Öffnung (16) in Verknüpfung mit der Entzündung der Gase an dieser Stelle zu verhindern.

2. Entgasungssystem (8) für eine elektrische Speicher-Batterie (2) nach Anspruch 1, dadurch gekennzeichnet, daß der Durchbruch (32) eine Querschnittsfläche von nicht mehr also einer Hälfte der Querschnittsfläche der Öffnung (16) besitzt.

#### Revendications

1. Système (8) de mise à l'air pour un accumulateur électrique (2) comprenant un orifice d'échappement (16) pour mettre à l'atmosphère ambiante les gaz de l'accumulateur, et des moyens pour étouffer toute flamme envahissant ledit système à travers ledit orifice (16), ces moyens comprenant un filtre poreux (24) d'arrêt des flammes disposé entre un élément (17) de l'accumulateur (2) et ledit orifice (16) afin de permettre la sortie des gaz tout en empêchant l'entrée de ladite flamme et une chambre de combustion (28) adjacente audit orifice (16) pour la combustion commandée desdits gaz dans celle-ci, caractérisé en ce que lesdits moyens pour étouffer la flamme comprennent une chambre d'amortissement (26) entre ladite chambre de combustion (28) et ledit filtre (24) pour atténuer le choc de ladite combustion commandée sur ledit filtre (24), une cloison (30) séparant lesdites chambres de combustion et d'amortissement (26, 28) l'une de l'autre, et une ouverture (32) à travers ladite cloison (30) reliant lesdites chambres de combustion et d'amortissement, ladite ouverture (32) ayant une section transversale efficace qui est suffisamment inférieure à la section transversale dudit orifice (16) pour que les forces engendrées par ladite combustion commandée soient libérées principalement à travers ledit orifice (16) et servent à empêcher l'établissement d'une flamme entretenue audit orifice (16) à la suite de l'allumage des gaz dans cet orifice.

2. Système (8) de mise à l'air pour un accumulateur électrique (2) suivant la revendication 1, caractérisé en ce que ladite ouverture (32) présente une section transversale qui n'est pas supérieure à la moitié de la section transversale dudit orifice (16).

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